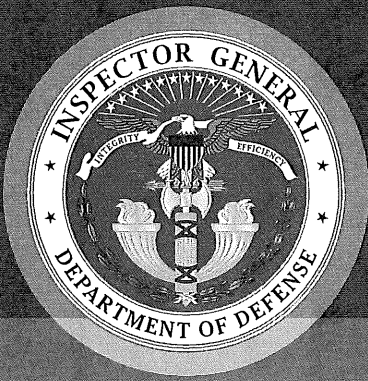


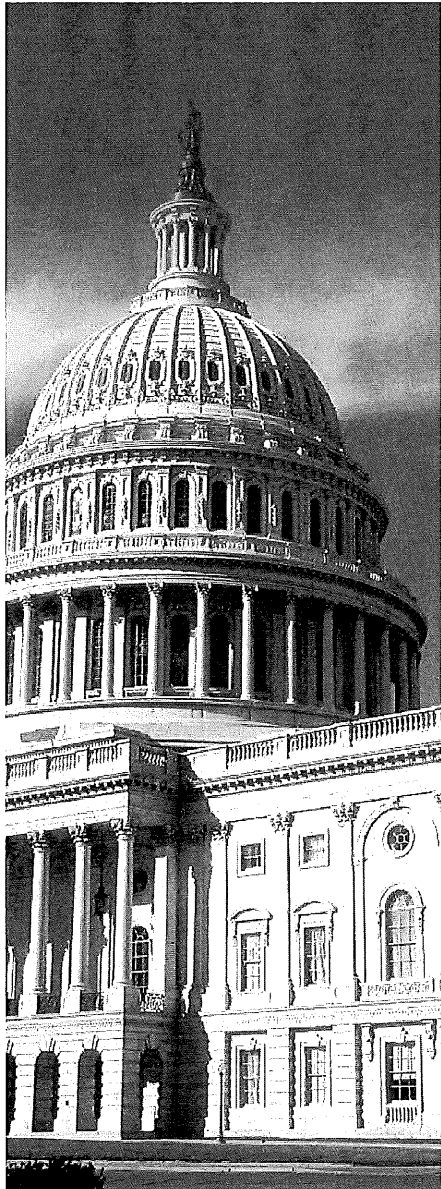
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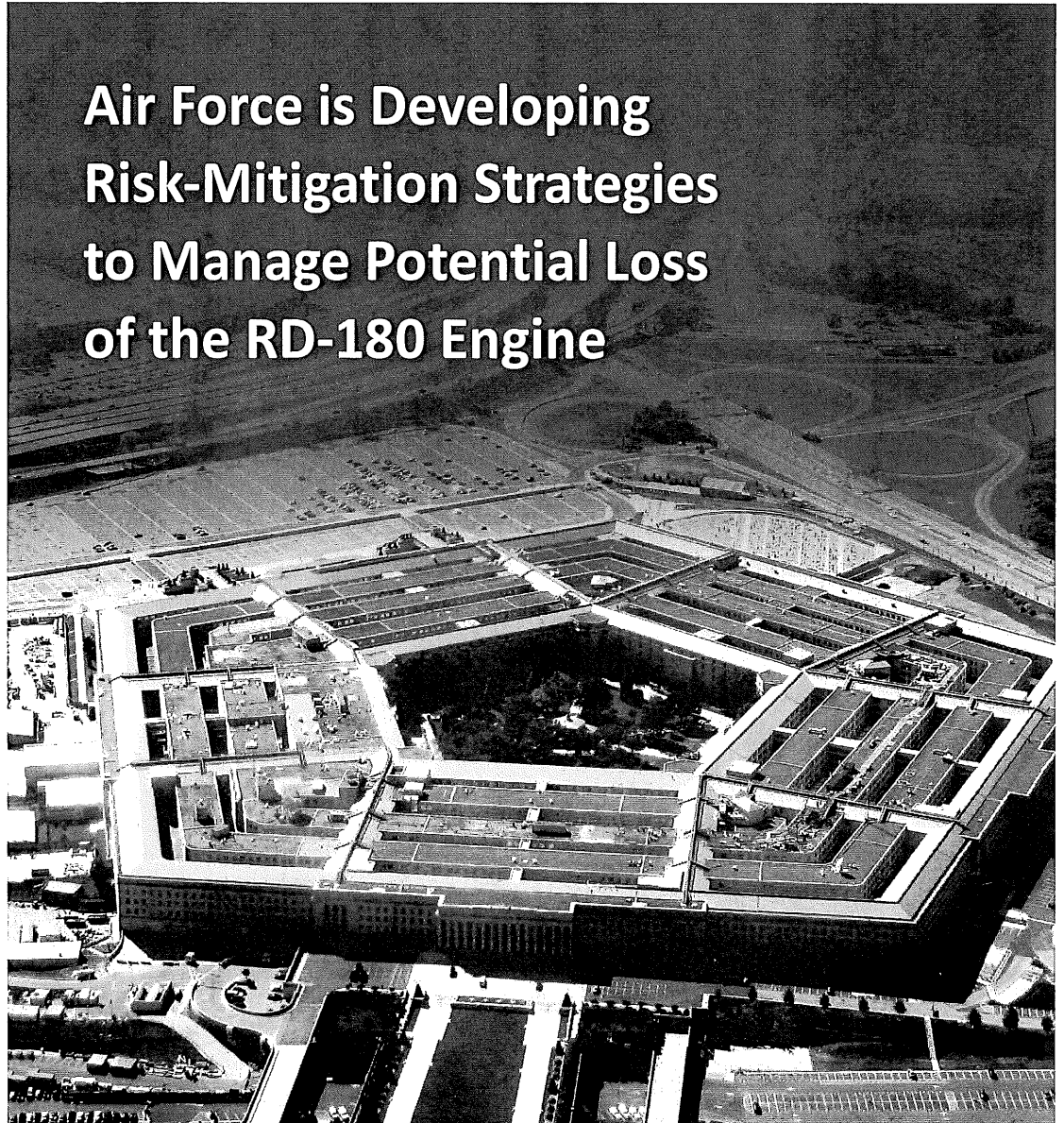
# **INSPECTOR GENERAL**

*U.S. Department of Defense*

MARCH 5, 2015



## **Air Force is Developing Risk-Mitigation Strategies to Manage Potential Loss of the RD-180 Engine**



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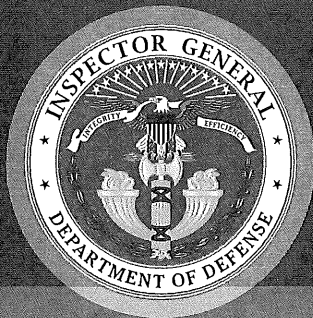
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## Results in Brief

### *Air Force is Developing Risk-Mitigation Strategies to Manage Potential Loss of the RD-180 Engine*

March 5, 2015

### Objective

We performed this audit in response to Congressional requests on the Evolved Expendable Launch Vehicle. We determined whether the Air Force implemented the recommendations in the RD-180 Availability Risk-Mitigation Study.

### Finding

The RD-180 Availability Risk-Mitigation Study identified 4 key findings with recommendations to manage concerns with the RD-180 engine.

- Study Finding 1 had 4 recommendations. The Air Force fully or partially implemented all 4 recommendations.
- Study Finding 2 had 1 recommendation. The Air Force partially implemented this recommendation.
- Study Finding 3 had 1 recommendation. The Air Force implemented this recommendation.
- Study Finding 4 had 4 recommendations. The Air Force fully or partially implemented 2 out of 4 recommendations.

### *Finding (cont'd)*

The Air Force did not specifically implement all recommendations made in the RD-180 Availability Risk-Mitigation Study; however, they developed risk-mitigation strategies to manage the potential loss of the RD-180 engine. Therefore, we are not making recommendations in this report.



**INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE  
4800 MARK CENTER DRIVE  
ALEXANDRIA, VIRGINIA 22350-1500**

March 5, 2015

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION,  
TECHNOLOGY, AND LOGISTICS  
ASSISTANT SECRETARY OF THE AIR FORCE (FINANCIAL  
MANAGEMENT AND COMPTROLLER)

SUBJECT: Air Force is Developing Risk-Mitigation Strategies to Manage Potential Loss  
of the RD-180 Engine (Report No. DODIG-2015-086)

We are providing the enclosed charts for your information and use. We performed this audit in response to Congressional requests on the Evolved Expendable Launch Vehicle (EELV) program from the Honorable Darrell Issa, former Chairman, Committee on Oversight and Government Reform and the Honorable John McCain, former Ranking Member, Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs. Our audit objective was to determine whether the Air Force implemented the recommendations in the RD-180 Availability Risk-Mitigation Study. We reviewed the Air Force's actions as a result of the study's findings and recommendations. We conducted this audit in accordance with generally accepted government auditing standards.

~~(FOUO)~~ On March 19, 2014, the Assistant Secretary of the Air Force (Acquisition) (SAF/AQ) issued a memorandum initiating a quick-reaction review to focus on issues, risks, costs, and options concerning the potential loss of the RD-180 engine resulting from tensions between the U.S. and Russia over the crisis in Ukraine. The RD-180 is a critical component to the success of the EELV program. The loss of RD-180 engines would significantly impact the cost and schedule of the EELV program and risks to national security.

~~(FOUO)~~ On April 22, 2014, the RD-180 Availability Risk-Mitigation Study team identified four key findings with recommendations to manage concerns about the RD-180 engine. On May 27, 2014, SAF/AQ generally concurred with the RD-180 Availability Risk-Mitigation Study recommendations and issued a memorandum, "EELV RD-180 Study Findings & Recommendations, Actions and Engine Acquisition Strategy" (SAF/AQ Action Memo), detailing several action items to address the study findings. Air Force officials stated the SAF/AQ Action Memo defined the way forward.

~~(FOUO)~~ The Air Force EELV program acquired satellite launch services from United Launch Alliance for military and intelligence missions from two families of launch vehicles—the Atlas V and Delta IV.<sup>1</sup> The Atlas V was powered by the Russian-made RD-180 engine. The EELV program strategy contained phases 1, 1a, 2, and 3. The Air Force estimated procuring launch services during Phase 1 from FYs 2013 through 2017. Phase 1a would include up to nine additional competitively-awarded launches from FYs 2015 through 2017. Phases 2 and 3 would include procurement competition among certified providers from FYs 2018 through 2022 and FYs 2023 through 2030, respectively.

<sup>1</sup> The Delta IV is powered by the U.S.-made RS-68 engine.

(FOUO) According to Air Force officials, as of November 2014, United Launch Alliance had <sup>USA</sup>~~(b)~~ RD-180 engines in its inventory. In addition, according to an Air Force briefing, United Launch Alliance officials believe the risk of RD-180 engine supply interruption was very low, and all 2014 RD-180 engine deliveries were received as expected. Furthermore, according to Air Force officials, the first Atlas V Phase 1 launch occurred on December 12, 2014, and the last launch is scheduled for March 2019.

We determined the Air Force developed risk-mitigation strategies even though they were not specifically implementing all of the recommendations made in the RD-180 Availability Risk-Mitigation Study. The risk-mitigation strategies were a result of the RD-180 Availability Risk-Mitigation Study findings and recommendations; the SAF/AQ Action Memo; and the Air Force's existing processes.

We considered Air Force comments on a draft of the enclosed charts. No further action is necessary. We appreciate the courtesies extended to the staff. Please direct questions to me at (703) 604-<sup>(b)(6)</sup> (DSN 664-<sup>(b)(6)</sup>).

*Jacqueline L. Wicecarver*  
Jacqueline L. Wicecarver  
Assistant Inspector General  
Acquisition, Parts, and Inventory

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## RD-180 AVAILABILITY RISK-MITIGATION STUDY FINDINGS

- Study Finding 1: Impacts of an RD-180 loss are significant, and near-term (FY 2014 through FY 2017) options to mitigate them are limited.
  - Finding 1 had 4 recommendations.
- Study Finding 2: There are decision points that will provide indicators on the viability of the RD-180.
  - Finding 2 had 1 recommendation.
- Study Finding 3: Phase 1a/2 of the EELV acquisition strategy is impacted by RD-180 availability.
  - Finding 3 had 1 recommendation.
- Study Finding 4: Key milestones/decision points for the EELV acquisition strategy will need to be addressed by FY 2022 (Phase 3).
  - Finding 4 had 4 recommendations.



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## STUDY RECOMMENDATIONS AND AIR FORCE ACTIONS SUMMARY

Summarized RD-180 Availability Risk-Mitigation Study Recommendations	Recommendation Implemented?	Air Force Risk-Mitigation Strategies
<b>Recommendation 1.a</b> Accelerate RD-180 engine buy; facilitate Phase 1a/2 competition; avoid U.S. production of the RD-180.	Yes	The Air Force implemented Recommendation 1.a.
<b>Recommendation 1.b</b> Integrate Atlas V payloads onto the Delta IV; create and maintain a stockpile of Delta IV long lead items.	Partially	<del>(FOUO)</del> Air Force contracted with United Launch Alliance (ULA) to conduct studies on whether Atlas V payloads can be integrated on Delta IV - estimated completion date of August 2015. ULA maintains a stockpile of Delta IV engines and can increase production of other long lead items on-demand.
<b>Recommendation 1.c</b> Certify new launch providers; complete integration studies; accelerate payload integration analysis; validate payload integration design and accelerate capability at launch sites.	Partially	<del>(FOUO)</del> Air Force awarded contracts to Space Exploration Technologies Corporation (SpaceX) for studies to determine if Atlas V payloads can be launched on its rocket - estimated completion date of May 2015. Air Force will require verification that SpaceX can meet payload integration requirements prior to being awarded Phase 1a launches. Air Force does not intend to accelerate payload integration.
<b>Recommendation 1.d</b> Increase investment for liquid oxygen/hydrocarbon-fueled rocket engine technology risk reduction.	Partially	<del>(FOUO)</del> SAF/AQ stated it was premature to choose a specific engine technology and development strategy. To ensure the availability of domestic engines, the Air Force presented a notional engine development strategy and several courses of action regarding new engine development to the Defense Space Council (DSC).
<b>Recommendation 2</b> Track near and far-term decision points that provide indicators on the viability of the RD-180 and respond based on actions taken at decision points.	Partially	OSD/JS: (b) (4), (b) (5)
<b>Recommendation 3</b> Reassess Phase 1a/2 competition and acquisition strategies assuming no RD-180s beyond those in country.	Yes	The Air Force implemented Recommendation 3.
<b>Recommendation 4.a</b> Issue an Acquisition Decision Memo to direct new liquid oxygen/hydrocarbon-fueled rocket engine technology to provide options for EELV Phase 3 including a next generation launch vehicle and full funding in FY 2016 Program Objective Memorandum.	No	<del>(FOUO)</del> SAF/AQ stated it was premature to choose a specific engine technology and development strategy for future launches. The Air Force is developing a strategy and initiating an effort to ensure domestic engine availability.
<b>Recommendation 4.b</b> Create a joint Air Force/NASA Program Office to manage investment in liquid oxygen/hydrocarbon-fueled rocket engine technology risk reduction phase and provide options for engines and new launch vehicles for the EELV Phase 3 Acquisition Strategy.	No	<del>(FOUO)</del> NASA is no longer investing in liquid oxygen/hydrocarbon-fueled rocket engine technology. The Air Force worked with NASA to identify alternative engine designs to meet both the Air Force and NASA performance needs. The Air Force consistently works with NASA under memorandums of understanding. The Air Force briefed five options for acquisition strategies to the DSC.
<b>Recommendation 4.c</b> Incorporate new engines and launch vehicles as alternatives in Phase 3 Acquisition Strategy while considering private-public partnership arrangements and new entrants.	Partially	<del>(FOUO)</del> Air Force received 27 responses to a request for information on potential options to replace RD-180. Air Force presented several courses of action for new engine and launch vehicle development to the DSC. Air Force did not start the Phase 3 Acquisition Strategy because it needs to first determine the Phase 2 Acquisition Strategy.
<b>Recommendation 4.d</b> Minimize dependence on foreign components for U.S. launch vehicles while maintaining a competitive environment.	Yes	The Air Force implemented Recommendation 4.d.

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## RECOMMENDATION 1.A IMPLEMENTED

- Air Force and United Launch Alliance (ULA) officials are implementing Recommendation 1.a to accelerate RD-180 engine buys to preserve the Phase 1 schedule, facilitate Phase 1a/2 competition, and avoid U.S. production of the RD-180.
- (FOUO) According to Air Force officials, ULA accelerated RD-180 deliveries to increase stockpiled inventory.
  - OSD JS: (b) (4), USAF: (b) (4)
  - (FOUO) A 2-year stockpile of RD-180 engine inventory will enable transition to the Delta IV if the RD-180 engine is restricted.
- (FOUO) ULA has the ability to produce the RD-180 in the U.S. However, DoD will not initiate production because the cost is prohibitive, and it would not improve the current situation.
  - (FOUO) The Air Force reported that it would cost \$ OSD JS: (b) (4), USAF: (b) (4) more per RD-180 to produce the engine in the U.S. and that ULA estimated an additional \$ OSD JS: (b) (4), USAF: (b) (4) investment, would be required to stand up U.S. production facilities.



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## RECOMMENDATION 1.B PARTIALLY IMPLEMENTED

- The Air Force is partially implementing Recommendation 1.b to integrate Atlas V payloads onto the Delta IV, as well as create and maintain a stockpile of Delta IV long lead items such as engines.
  - Contracts awarded by the Air Force to study the compatibility of Atlas V payloads with the Delta IV are in process but will not be completed until August 2015.
- SAF/AQ directed Air Force officials to:
  - ~~(FOUO)~~ initiate integration studies of Atlas V payloads on the Delta IV;
  - ~~(FOUO)~~ assess the cost and schedule to increase Delta IV production and launch capacity; and
  - ~~(FOUO)~~ assess the feasibility of increasing the Delta IV launch capability.
- In August 2014, the Air Force contracted with ULA to determine whether they could integrate and launch Atlas V payloads on the Delta IV.
  - The studies will be completed by August 2015.



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## RECOMMENDATION 1.B PARTIALLY IMPLEMENTED (CONT'D)

○ According to Air Force officials:

- OSD/JS: (b) (4); USAF: (b) (4)  
[REDACTED]
  - ~~(FOUO)~~ The acceleration would not require any production facility improvements
  - ~~(FOUO)~~ Cost increases attributed to an acceleration would be minimal
    - ~~(FOUO)~~ Approximately OSD/JS: (b) (4); USAF: (b) (4) cost increase for additional tooling equipment and long-lead material
    - ~~(FOUO)~~ No additional manpower requirements, as experienced personnel supporting Atlas V can be shifted to Delta IV production
    - ~~(FOUO)~~ Rocket transportation capability can support OSD/JS: (b) (4); USAF: (b) (4) per year to the launch facility
- ~~(FOUO)~~ ULA's Delta IV launch capacity could increase from OSD/JS: (b) (4); USAF: (b) (4) launches per year.
  - ~~(FOUO)~~ Increasing Delta IV launch capacity would require OSD/JS: (b) (4); USAF: (b) (4) investment for launch site upgrades and additional launch support manpower.
- With regard to the Delta IV supply chain:

OSD/JS: (b) (4); USAF: (b) (4)



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## RECOMMENDATION 1.C PARTIALLY IMPLEMENTED

- The Air Force is partially implementing Recommendation 1.c to:
  - complete payload compatibility studies;
  - accelerate payload integration analysis; and
  - validate payload integration design and accelerate integration capability at Space Exploration Technologies Corporation (SpaceX)<sup>1</sup> launch sites.
- The Air Force does not intend to accelerate integration capabilities at SpaceX launch sites because of the studies it directed, but will require verification that SpaceX can meet payload integration requirements through a mature capability design and supporting information prior to being awarded Phase 1a launches.
- ~~(FOUO)~~ SAF/AQ directed Air Force officials to complete Atlas V payload integration studies on the SpaceX rocket.
  - ~~(FOUO)~~ From March through May 2014, the Air Force contracted with SpaceX to conduct integration studies to determine if Atlas V payloads could be launched on its rocket.
  - ~~(FOUO)~~ The studies should be completed by May 2015.
- ~~(FOUO)~~ Air Force officials expect SpaceX to obtain its launch certification in 2015.

<sup>1</sup> ~~(FOUO)~~ SpaceX is a new launch provider expecting to complete DoD launch certification for its rocket to carry EELV payloads in 2015. Once SpaceX obtains its launch certification it will be eligible to compete for Phase 1a (FYs 2015 through 2017) EELV contracts.



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## RECOMMENDATION 1.D PARTIALLY IMPLEMENTED

- The Air Force is partially implementing Recommendation 1.d to increase investment (approximately \$141 million) in liquid oxygen/hydrocarbon-fueled rocket engine technology to reduce launch risk.
- ~~(FOUO)~~ SAF/AQ stated it was premature to choose a specific engine technology and development strategy. There are different rocket engine fuel types the Air Force could select for future launch capability development. SAF/AQ directed the Air Force to develop a strategy and initiate an effort to ensure the availability of domestic engines.
  - In FY 2014, the Air Force increased investment in new engine technology risk reduction by approximately \$40 million but did not specify that funding was to be invested in liquid oxygen/hydrocarbon-fueled engine technology.
  - ~~(FOUO)~~ On August 20, 2014, Air Force officials issued a Request for Information (RFI) to the launch system and engine industry requesting the following:
    - *Proposed technical approach to a new engine development;*
    - *Business case including shared investment for a new engine development program;*
    - *Areas of identifiable risk surrounding new engine development; and*
    - *Partnering plans for a new engine development.*
  - ~~(FOUO)~~ Based on the RFI results, Air Force officials presented a notional engine development strategy and several courses of action regarding new engine development to the Defense Space Council (DSC).<sup>2</sup> On October 29, 2014, the Deputy Management Action Group (DMAG)<sup>3</sup> met to review DoD space programs, specifically to discuss FY 2016 engine development funding.
- An OSD official explained that once the FY 2016 budget is allocated, the Air Force will determine which alternative they want to pursue based on the funding received.

<sup>2</sup> The DSC is a principal advisory forum to inform, coordinate, or resolve all Defense space issues.

<sup>3</sup> The DMAG provides information to the Deputy Secretary of Defense (DEPSECDEF) to determine how much money to allocate to each program.



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## RECOMMENDATION 2 PARTIALLY IMPLEMENTED

- The Air Force partially implemented Recommendation 2 to track near-term (April through October 2014) and far-term (FY 2015 through FY 2017) events, which provide indicators on the viability of the RD-180, and respond based on actions taken.
- ~~(FOUO)~~ According to Air Force officials, all near-term events occurred as planned culminating in the delivery of five RD-180 engines to ULA in 2014. Air Force officials stated ULA received two RD-180 engines in August, two in October, and one in November 2014. Although not all near-term events directly or indirectly impacted RD-180 deliveries, according to Air Force officials, the events occurred as planned indicating business as usual on RD-180 deliveries.
  - ~~(FOUO)~~ For example, in April 2014, a spare parts delivery occurred as planned. Additionally, between April and November 2014, RD-180 on-site support for a DoD Atlas V launch occurred and the Government of Russia approved RD-180 license exports.



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## RECOMMENDATION 2 PARTIALLY IMPLEMENTED (CONT'D)

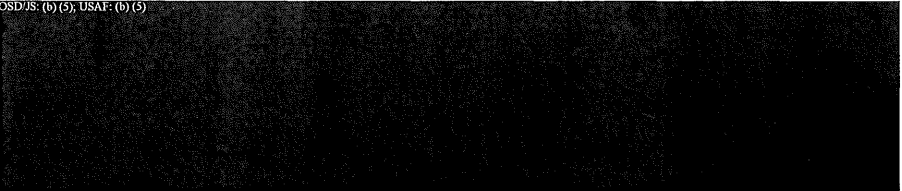
- ~~(FOUO)~~ Air Force officials stated they were aware of the far-term events but only tracked RD-180 engine deliveries to ULA and began analyzing courses of action for an RD-180 engine alternative, including co-producing in the U.S. The other events required either no Air Force action or no action for at least 2 years. For example, the Air Force is not tracking the technical assistance agreement since it will continue to be in place for 2 more years.
- ~~(FOUO)~~ Air Force officials track RD-180 engine matters through the EELV program's risk management process. The RD-180 engine is one risk element Air Force officials assess to manage program risk and assure access to space for DoD missions.
- ULA is contractually obligated to manage its supply chain, including subcontractors and all Atlas V production and transportation activities, and provide successful launches until the final Phase 1 launch scheduled for March 2019.



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## RECOMMENDATION 3 IMPLEMENTED

- The Air Force implemented Recommendation 3 to reassess Phase 1a/2 competition and acquisition strategies assuming ULA will not receive additional RD-180s beyond those in country.
- ~~(FOUO)~~ The Air Force worked with the DSC to reassess and develop five options for Phases 1a, 2, and 3 competition and acquisition strategies, to include:
  - OSD/JS: (b) (5); USAF: (b) (5)  

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- According to an OSD official, RD-180 alternatives will be determined following a DMAG decision that will support the FY 2016 budget submission.



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## RECOMMENDATION 4.A NOT IMPLEMENTED

- The Air Force is not implementing Recommendation 4.a to issue an Acquisition Decision Memorandum to:
  - direct new liquid oxygen/hydrocarbon-fueled rocket engine technology to provide options for EELV Phase 3;
  - include a next generation launch vehicle; and
  - direct full funding in FY 2016 Program Objective Memorandum.
- ~~(FOUO)~~ SAF/AQ stated it was premature to choose a specific engine technology and development strategy. There are several different rocket engine fuel types that the Air Force could select for future launch capability development. SAF/AQ directed the Air Force to develop a strategy and initiate an effort to ensure the availability of domestic engines.
  - On August 20, 2014, Air Force officials published an RFI to obtain potential options for an RD-180 replacement engine from industry. The Air Force requested engine replacements and new launch vehicle systems to consider for future launch capability and development.
  - On September 24-26, 2014, the Air Force held Industry Day and met with organizations that responded to the August 20, 2014 RFI.
  - ~~(FOUO)~~ Air Force officials presented a notional engine development strategy and several courses of action regarding new engine development to the DSC. On October 29, 2014, the DMAG met to review DoD space programs, specifically to discuss FY 2016 engine development funding.
  - According to an OSD official, once the DEPSECDEF decides how much money to allocate to the program, the Air Force will obtain approval for their selected alternative from the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics [OUSD(AT&L)] through processes required by the Defense Acquisition System.



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## RECOMMENDATION 4.A NOT IMPLEMENTED (CONT'D)

- In addition, SAF/AQ directed the Air Force to:
  - ~~(FOUO)~~ identify funds and work with Congress to obtain the necessary authorities in FY 2014 to initiate a new domestic engine and risk-reduction program; and
  - ~~(FOUO)~~ continue to work with Congress to identify FY 2015 bridge funding to address the early phases of a new program.
- ~~(FOUO)~~ In FY 2014, the Air Force received \$45 million for new engine technology risk-reduction development and technology maturation.
- For FY 2015, Congress authorized the Air Force to spend \$220 million for an RD-180 replacement engine.



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## RECOMMENDATION 4.B NOT IMPLEMENTED

- The Air Force is not implementing Recommendation 4.b to create a joint Air Force/NASA Program Office to manage investment in liquid oxygen/hydrocarbon-fueled rocket engine technology risk-reduction phase and provide options for engines and new launch vehicles for the EELV Phase 3 Acquisition Strategy.<sup>4</sup>
- Alternatively, SAF/AQ directed the Air Force to:
  - ~~(FOUO)~~ solicit participation from the relevant space launch communities in Defense, U.S. Intelligence Agencies, NASA, and other applicable civilian agencies for an engine development strategy; and
  - ~~(FOUO)~~ work with NASA regarding the requirements and funding necessary to meet its space launch needs.
- In 2011, the Air Force, National Reconnaissance Office, and NASA signed a memorandum of understanding for the EELV program. The memorandum documents agreement for assured long-term access to space across these agencies.
- On May 8, 2014, the Air Force received a letter from NASA that stated it would no longer pursue liquid oxygen/hydrocarbon-fueled rocket engine, technology-based risk reduction.

<sup>4</sup> Phase 3 begins in FY 2023. The Air Force Phase 3 Acquisition Strategy has not been developed because the Air Force needs to first complete the Phase 2 Acquisition Strategy.



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## RECOMMENDATION 4.B NOT IMPLEMENTED (CONT'D)

- The Air Force stated they partnered with NASA in 2012 to study alternative engine options. NASA published two studies with alternatives for joint-use engines evaluating cost and technical feasibility.
  - NASA released a report in March 2014 explaining that the Air Force identified three alternatives to continue providing upper stage engines to reach a higher orbit. The Air Force alternatives address the concerns of the Air Force and NASA stakeholders and meet flight manifest needs.

- OSD/JS: (b) (5); USAF: (b) (5)

- ~~(FOUO)~~ On October 9, 2014, the Air Force briefed five options for acquisition strategies to the DSC:

- OSD/JS: (b) (5); USAF: (b) (5)



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## RECOMMENDATION 4.C PARTIALLY IMPLEMENTED

- The Air Force is partially implementing Recommendation 4.c to incorporate new engines and launch vehicles as alternatives in the Phase 3 Acquisition Strategy while considering private-public partnership arrangements and new entrants.
- The Air Force has not started the Phase 3 Acquisition Strategy because the Air Force needs to first determine the Phase 2 Acquisition Strategy.
  - Phase 3 begins in FY 2023
- However, SAF/AQ directed the Air Force to:
  - (FOUO) develop a strategy and initiate an effort to ensure the availability of domestic engines capable of meeting national security needs; and
  - (FOUO) maximize competition opportunities and consider private-public partnerships while placing a priority on schedule.
- On August 20, 2014, the Air Force issued an RFI to obtain potential options for an RD-180 replacement engine. The Air Force requested both engine replacements and new launch vehicle systems to consider for future launch capability development.
  - (FOUO) The Air Force received 27 responses to the RFI. Based on the initial RFI responses, we concluded the likelihood for new entrants is low without government investment.
- (FOUO) The Air Force presented several courses of action regarding new engine and launch vehicle development to the DSC. On October 29, 2014, the DMAG met to review DoD space programs, specifically to discuss FY 2016 engine development funding.



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## RECOMMENDATION 4.D IMPLEMENTED

- The Air Force is implementing Recommendation 4.d to minimize dependence on foreign components for U.S. launch vehicles while maintaining a competitive environment.
- ~~(FOUO)~~ In FY 2014, the Air Force received \$45 million for new engine technology risk-reduction development and technology maturation.
- On August 20, 2014, the Air Force issued an RFI to obtain unrestricted potential options for an RD-180 replacement engine and new launch vehicle systems to consider for future launch capability development.
  - The RFI allowed for a range of possible options to replace the engine and alternative configurations with similar performance to the current EELV program.
  - The RFI asked respondents to provide recommendations if the options presented included the use of non-U.S. sources.



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## RECOMMENDATION 4.D IMPLEMENTED (CONT'D)

- An OSD official drafted and submitted a preliminary program budget issue paper, which contained alternative rocket engine solutions.
- Air Force officials stated the recommendation to minimize dependence on foreign components for U.S. launch vehicles while maintaining a competitive environment will be reviewed as part of the DMAG process.
  - ~~(FOUO)~~ Air Force officials presented an engine development strategy and several courses of action regarding new engine development to the DSC. On October 29, 2014, the DMAG met to review DoD space programs, specifically to discuss FY 2016 engine development funding.
  - An Office of the Secretary of Defense representative explained that once the DEPSECDEF decides how much money to allocate to the program, the Air Force can determine a way forward.
- For FY 2015, Congress authorized the Air Force to spend \$220 million for an RD-180 replacement engine.



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## AUDIT SUMMARY

- The RD-180 Availability Risk-Mitigation Study identified four key findings with recommendations to manage concerns with the RD-180 engine.
- The SAF/AQ generally concurred with the RD-180 Availability Risk-Mitigation Study recommendations and issued the memorandum, "EELV RD-180 Study Findings & Recommendations, Actions and Engine Acquisition Strategy" (SAF/AQ Action Memo), dated May 27, 2014, directing several action items to mitigate the potential loss of RD-180 engines.
- The Air Force did not specifically implement all recommendations made in the RD-180 Availability Risk-Mitigation Study; however, they developed risk-mitigation strategies to manage the potential loss of the RD-180 engine.



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## SCOPE AND METHODOLOGY

- We conducted this performance audit from September 2014 through January 2015 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We did not validate any numbers provided by the Air Force during our review.
- We interviewed officials from the following offices responsible for, or participating in, the EELV program:
  - Office of the Secretary of the Air Force for Acquisition, Space Support and Surveillance Division;
  - Air Force Space Command;
  - Air Force Space and Missile Systems Center, Launch Systems Directorate;
  - Office of the Secretary of Defense, Cost Assessment and Program Evaluation; and
  - Office of the Secretary of Defense for Acquisition, Technology, and Logistics.
- We obtained and reviewed the following documents to determine if the Air Force implemented the RD-180 Availability Risk-Mitigation Study recommendations:
  - "RD-180 Accountability Matrix," November 12, 2014;
  - Headquarters U.S. Air Force briefing, "Reliably Sourced Propulsion System," DSC Update, October 09, 2014;
  - NASA "American Kerosene Engine Assessment," September 30, 2014;
  - Space and Missile Systems Center, Weekly Activity Reports, July 09, 2014 – November 12, 2014;
  - Headquarters U.S. Air Force briefing, "Domestic Propulsion Systems for National Security Space Launch," DSC Update, September 10, 2014;
  - Headquarters U.S. Air Force briefing, "Domestic Propulsion Systems for National Security Space Launch," DSC+1 Update, August 21, 2014;
  - "Booster Propulsion and Launch System Request for Information" August 20, 2014;
  - Space and Missile Systems Center briefing, "Response to EELV RD-180 Study," updated August 5, 2014;

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## SCOPE AND METHODOLOGY (CONT'D)

- Contract between Space and Missile Systems Center and United Launch Services, FA8811-13-C-0003 Modification P00047, August 4, 2014;
  - Headquarters U.S. Air Force briefing, "RD-180 DMAG," July 16, 2014;
  - Assistant Secretary of the Air Force (Acquisition) memorandum, "EELV RD-180 Study Findings & Recommendations, Actions and Engine Acquisition Strategy," May 27, 2014;
  - NASA Letter to Air Force, May 8, 2014;
  - "RD-180 Availability Risk-Mitigation Study," April 22, 2014;
  - NASA "Advanced Upper Stage Engine Program Assessment," March 31, 2014;
  - Assistant Secretary of the Air Force (Acquisition) memorandum, "RD-180 Availability Risk Mitigation Study Terms of Reference," March 19, 2014;
  - Contract between Space and Missile Systems Center and Space Exploration Technologies Corporation, FA8811-14-C-0003, March 10, 2014;
  - Contract between Space and Missile Systems Center and United Launch Services, FA8811-13-C-0003, June 26, 2013; and
  - "Memorandum of Understanding Among the United States Air Force, the National Reconnaissance Office, and National Aeronautics and Space Administration on Evolved Expendable Launch Vehicles," March 10, 2011.
- The RD-180 Availability Risk-Mitigation Study was performed by officials from OSD; Air Force; NASA; National Reconnaissance Office; and Aerospace Corporation.
  - We did not use computer-processed data or technical assistance to perform this audit.
  - Prior Audit Coverage during the last 5 years:
    - GAO-11-641, "Evolved Expendable Launch Vehicle: DOD Needs to Ensure New Acquisition Strategy is Based on Sufficient Information," September 2011
    - GAO-12-342SP, "2012 Annual Report: Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue," February 2012
    - GAO-12-822, "Evolved Expendable Launch Vehicle: DoD is Addressing Knowledge Gaps in Its New Acquisition Strategy," July 2012
    - GAO-13-317R, "Launch Services New Entrant Certification Guide," February 7, 2013
    - GAO-14-776T, "U.S. Launch Enterprise: Acquisition Best Practices Can Benefit Future Efforts," July 16, 2014



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## Acronyms and Abbreviations

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<b>DEPSECDEF</b>	Deputy Secretary of Defense
<b>DMAG</b>	Deputy Management Action Group
<b>DSC</b>	Defense Space Council
<b>EELV</b>	Evolved Expendable Launch Vehicle
<b>NASA</b>	National Aeronautics and Space Administration
<b>OSD</b>	Office of the Secretary of Defense
<b>OUSD(AT&amp;L)</b>	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
<b>RFI</b>	Request for Information
<b>SAF/AQ</b>	Assistant Secretary of the Air Force for Acquisition
<b>SpaceX</b>	Space Exploration Technologies Corporation
<b>ULA</b>	United Launch Alliance

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